

# Tidal Marsh Restoration in Suisun Marsh

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Making Science Work  
for Suisun Marsh  
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# Talk Goal

*To provide the audience with an understanding of the opportunities and challenges facing tidal marsh restoration in Suisun Marsh*



# **Talk Overview**

***Regional Restoration Targets***

***The Basics of Tidal Marsh and Their Restoration –  
Conceptual Models and the Big Picture***

***Site Issues Relevant to Suisun Marsh***

***Link to Next Two Talks – Regional View***



# Restoration Targets and Progress

- 5,000 to 7,000 acres –  
California Bay-Delta Authority
- 17,000 to 22,000 acres –  
Baylands Ecosystem Habitat Goals Report
- 0 acres –  
Restored since CBDA ROD and Goals Report
- 1,800 acres –  
Under construction (Montezuma)
- 290 acres –  
Active planning (Hill Slough, Blacklock)

**\*\* We are “re-creating” tidal marsh under modern conditions and constraints on lands where it once existed; we are not “restoring” the exact marshes of 1850 and before**



# Conceptual Model

## 1. *What is a Tidal Marsh?*

- Lands inundated by the daily tides
- Consist of
  - Vegetated marsh plains
  - Channel networks
  - Sometimes with ponds and/or pannes
- Islands or adjacent to upland
- Fundamentally, the physiographic template (the geomorphology) and the vegetation define available habitats at macro and micro scales
- Extensive physical and biological linkages





### Legend

- Bird Monitoring (Bird Monitoring Team, 10/29/03)
- ⬢ Water Level Station (Physical Processes Team, 01/08/04)
- Fish Monitoring Location (Fish Monitoring Team, 10/30/03)
- ☆ Piezometer (Physical Processes Team, 01/15/04)
- ✕ Cross Section Endpoint (Physical Processes Team, 01/08/04)
- Site Boundary

Notes:  
--Legend date represents most recent date from point survey(s)  
--Map labels represent point ID information provided by team







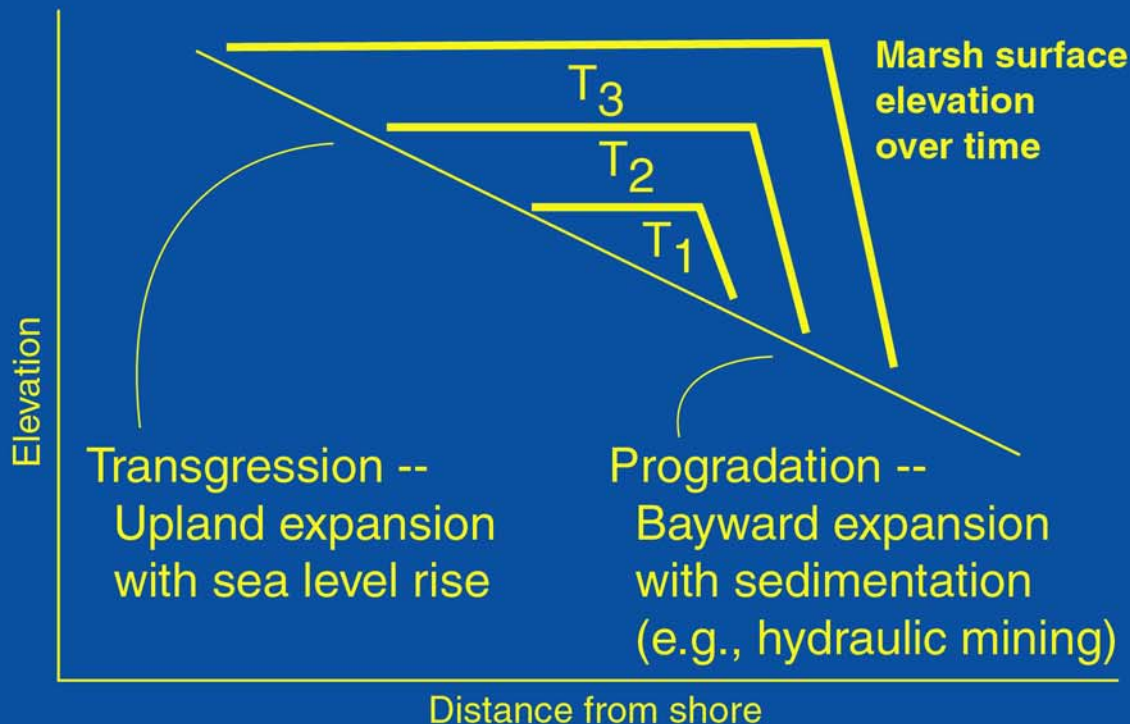


# Conceptual Model

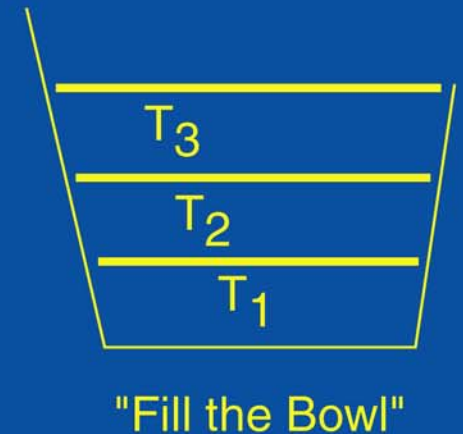
## *How Tidal Marsh Forms*

### Marsh Accretion Patterns, Natural and Restored

#### Natural Marsh Formation, "Slow"



#### Marsh Restoration, "Fast" (we hope)

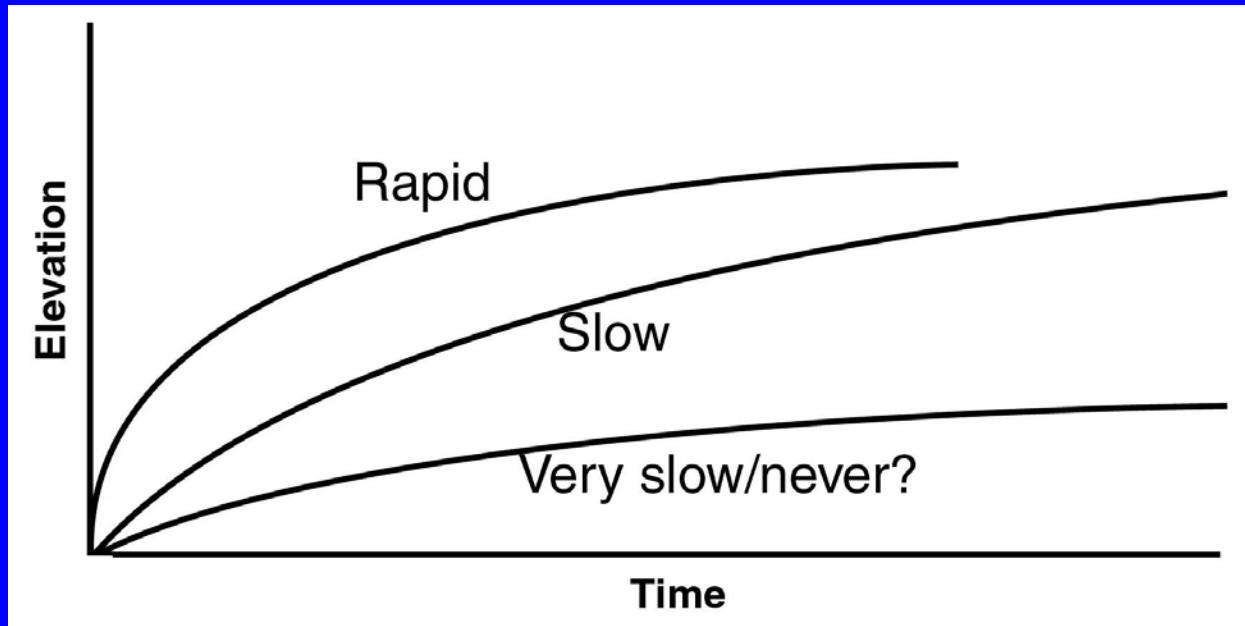






# Conceptual Model

## *Elevation Trajectories of Restored Tidal Marsh*

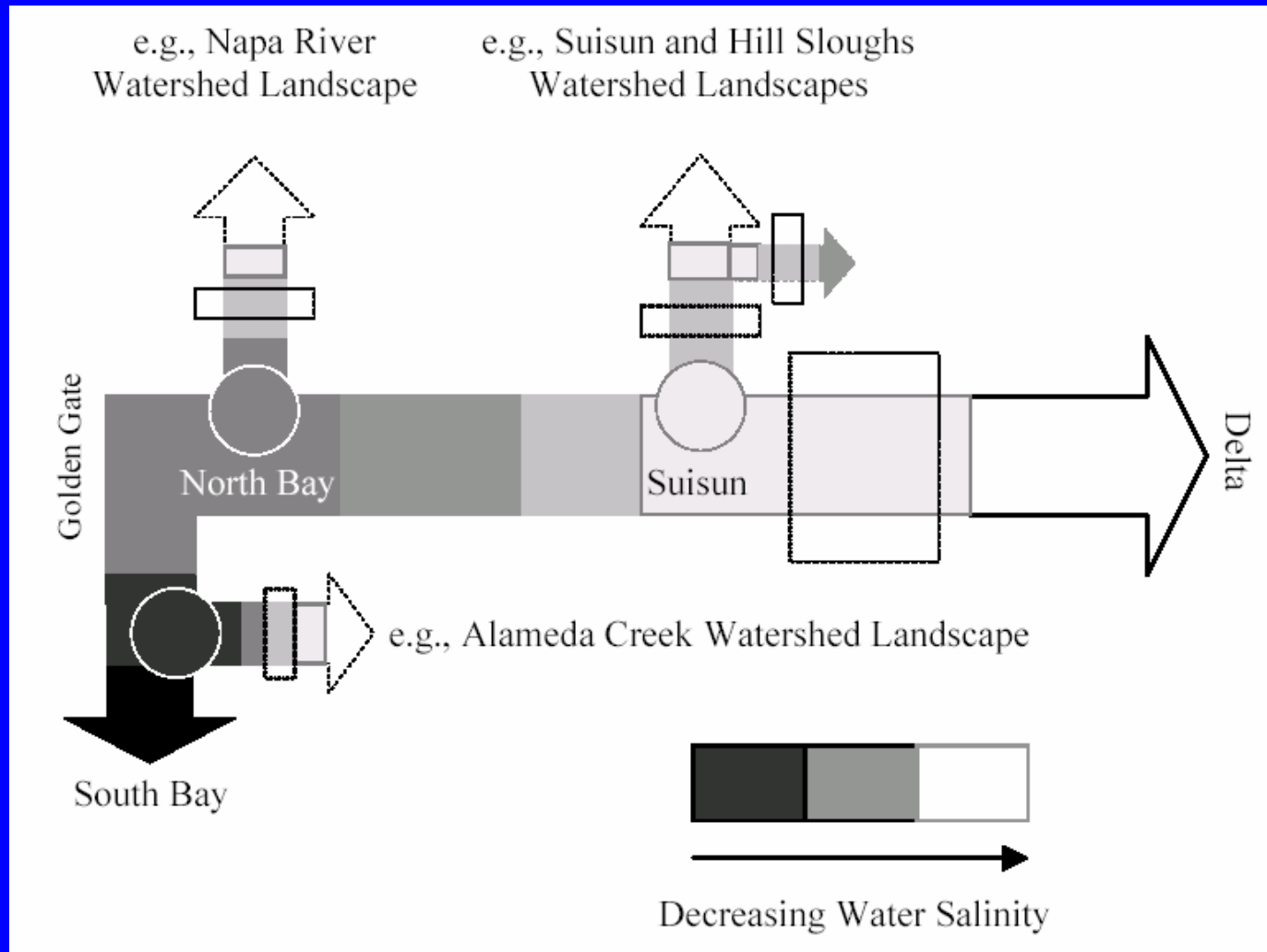


- Understand processes that drive elevation increases
- Be realistic in expectations
- Judgment to accept or reject



# Conceptual Model – External Controls

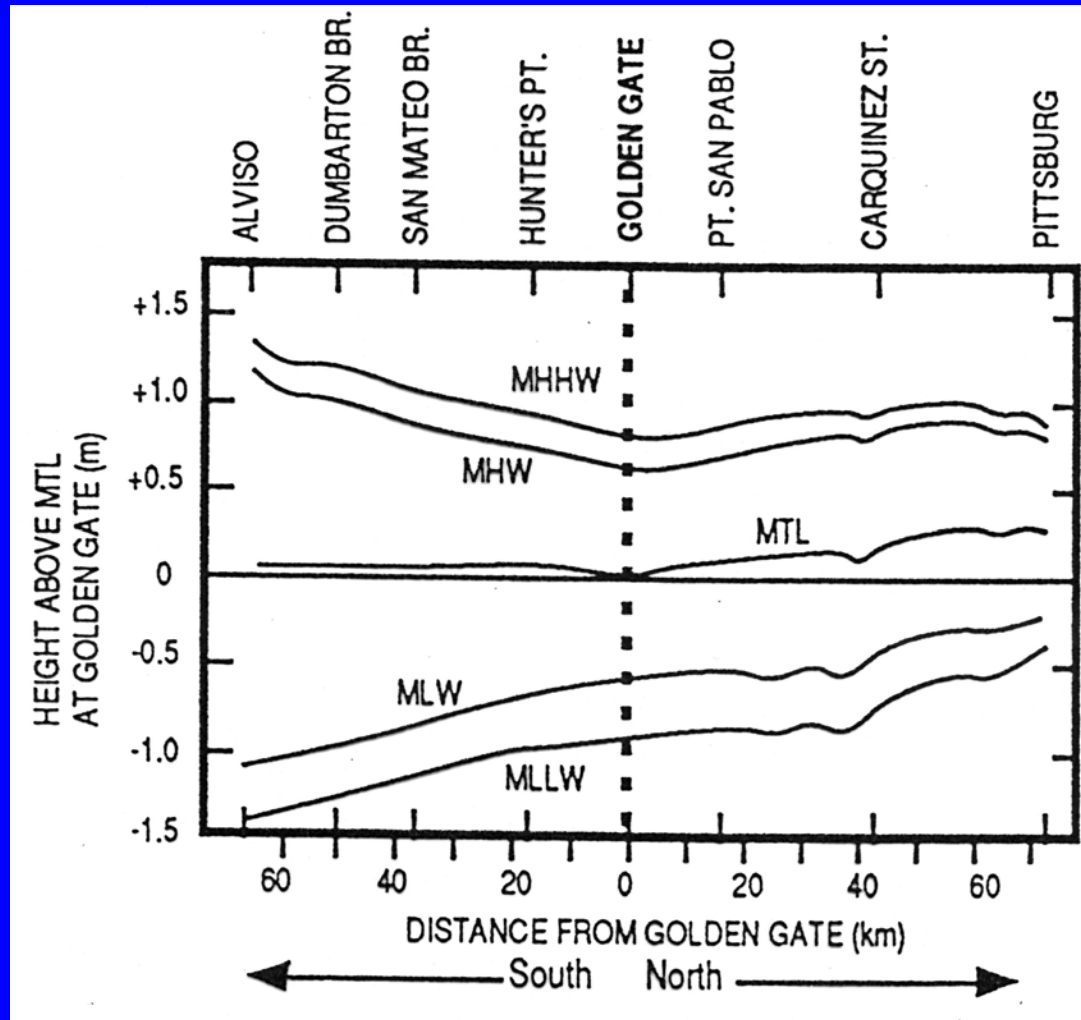
## A. Salinity Gradients





# Conceptual Model – External Controls

## B. Tidal Range Gradients



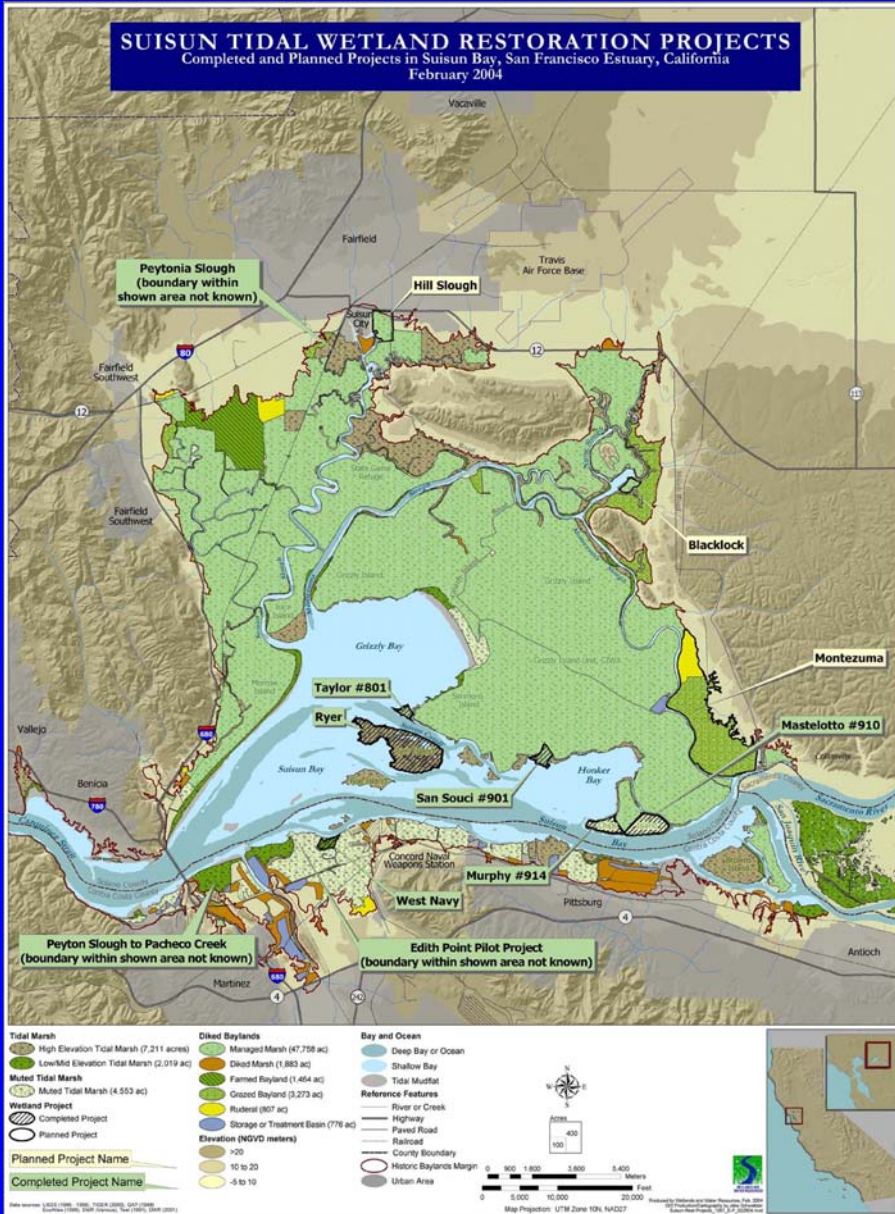




# Conceptual Model – External Controls

## C. Sediment Supply

- Vital to marsh growth and maintenance especially with sea level rise
- Large spatial and temporal variability:
  - Highly seasonal river and stream discharge
  - Proximity to Delta outflow as major sediment source
  - Proximity to mudflats for resuspension
  - Distance to sediment sources and loss en route
- Large magnitude, infrequent events can play a significant role especially where sediment supply otherwise limited
- Sediment supply may not be most significant contributor in some settings



# Conceptual Model

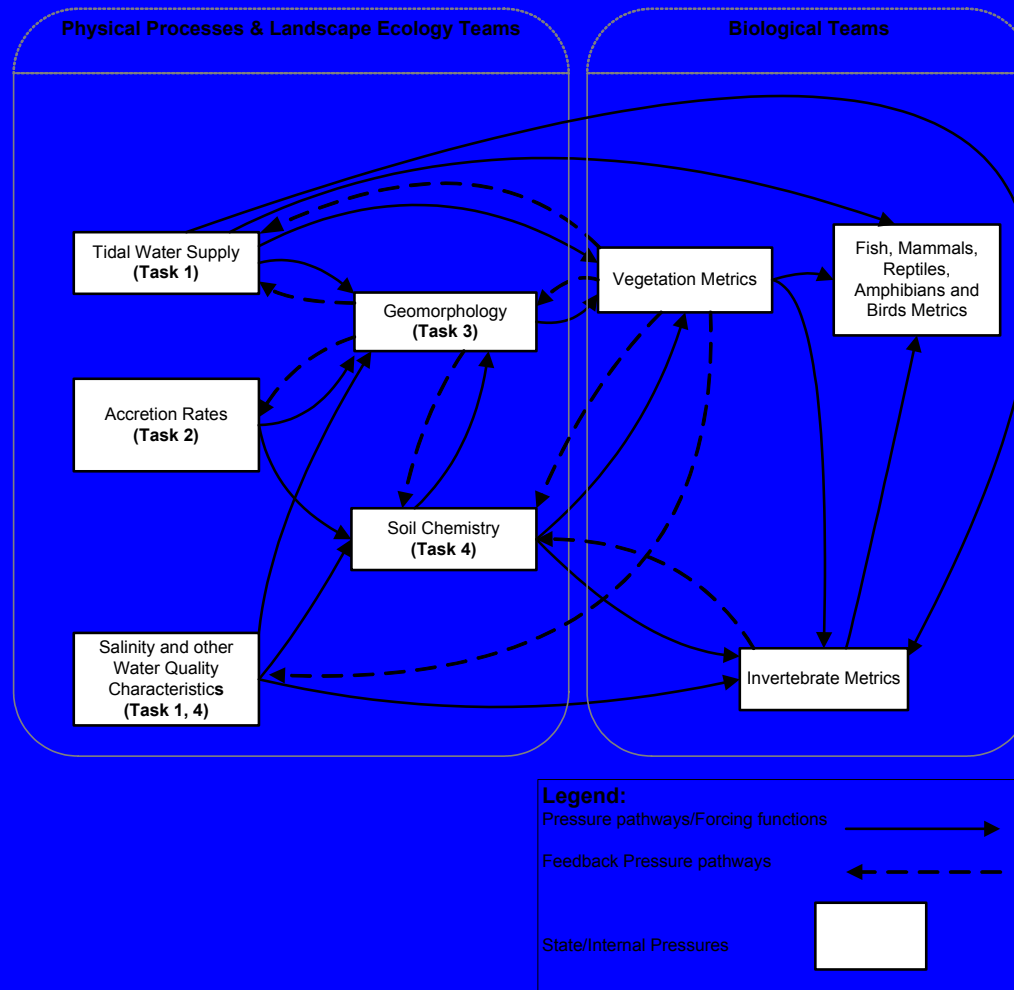
## Sediment Supplies for Suisun Marsh

Enough?



# Conceptual Model

## 4. Linkage Between Physical and Biological Processes







# Conceptual Model

## Internal Site Characteristics and the Baseline Conditions Hypotheses

- Degree of Subsidence
- Geomorphology
- Existing Plants
- Substrate Suitability for Target Flora and Fauna

*Hypothesis: there is a baseline threshold elevation at which initial dominant processes diverge, with a mix of biological (vegetation colonization) and physical (mineral sedimentation) processes above and predominantly physical processes below.*



# Site Issues for Suisun

1. Establishing effective tidal connections
2. Reversing subsidence
3. Establishing channel networks
4. Can we establish natural ponds?
5. What to do with perimeter levees
6. Managing exotic plant and animal species
7. Maintaining flood control
8. Working around infrastructure
9. Meeting vector control requirements
10. Contaminants
11. Regional effects on salinity, hydrodynamics, wildlife resources – next two talks (Enright, Takekawa)



# Site Issues for Suisun

## 1. Establishing Tidal Connections

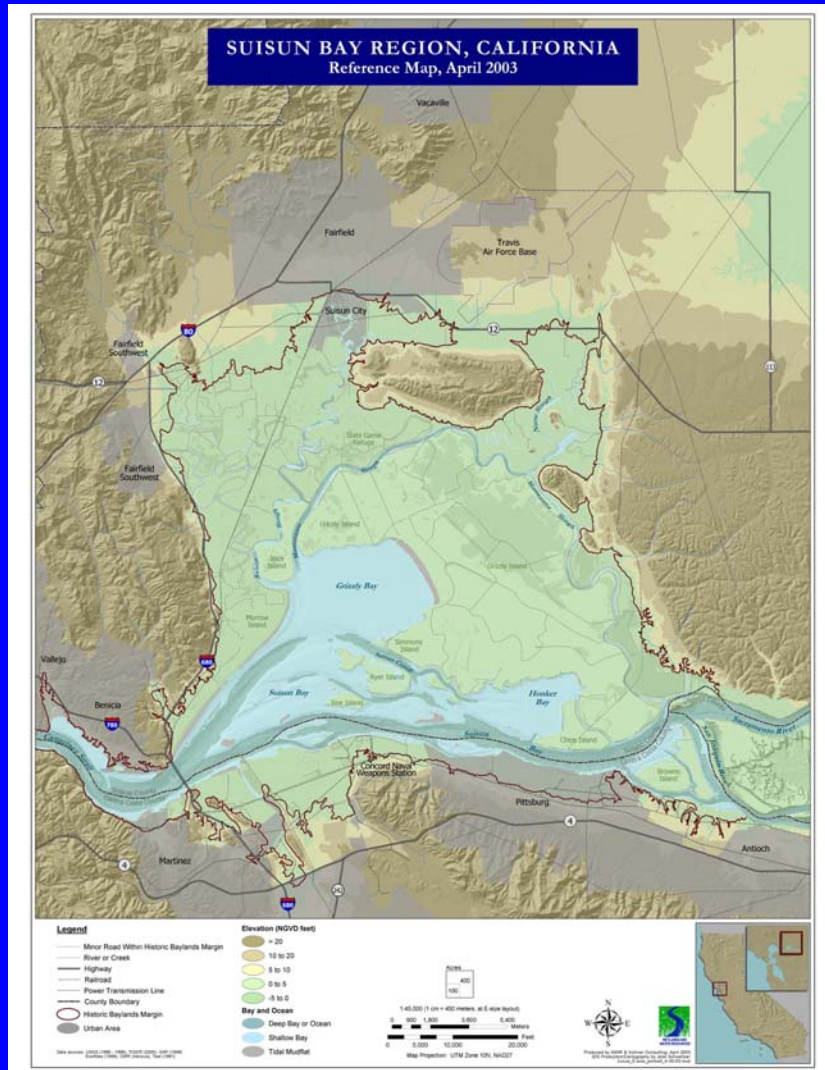
- Full, unrestricted tidal exchange is the hallmark of every successful tidal marsh restoration project
- Geometry for levee breach(es) considers the larger as-built as well as “equilibrium” tidal prism
- Levee breach siting considers external and internal factors, such as currents, winds, adjacent properties, extant channel networks, current topography and the like





# Site Issues for Suisun

## 2. Reversing Subsidence – Big Challenge



- Degree of subsidence varies within and between properties
- Common “wisdom” says on the order of ~1 to 4 feet; greater at some sites (Van Sickle, Montezuma, others?)
- We need good data on existing topography



# Site Issues for Suisun

## 2. Reversing Subsidence – Big Challenge

- Natural sedimentation
- Vegetation – peat accumulation and sediment trapping
- Fill placement such as dredged material
- Muted regimes with water control structures to lower effective intertidal elevations



# Site Issues for Suisun

## 3. Establishing Channel Networks

- **Extent of preserved historic channel network varies based largely on intervening land use since diking**
- **Suisun Marsh mainly managed wetlands:**
  - **Many new ditches constructed to manage water circulation**
  - **Borrow ditches around perimeter levees from construction and maintenance**
  - **Grading typically removes channels wholly or partially**
- **Tides and sedimentation tend to adopt morphology at breaching**
- **Methods for re-establishing channel network depend largely on the amount of subsidence and degree of site modifications**



# Site Issues for Suisun

## 4. Natural Ponds

- We learned from Robin Grossinger's *Historical Conditions* talk yesterday that the tidal marshes of Suisun once supported many ponds with tremendous waterfowl abundance
- Is it possible to recreate such ponds within tidal marsh restoration projects?
  - Little understanding of processes that formed and maintained ponds historically
  - Little understanding of processes that could form and maintain ponds in restoration projects
  - Hypersalinity? Avian foraging? No drainage?
- Ripe for investigation...



# Site Issues for Suisun

## 5. Perimeter Levees

- Options for fate of perimeter levees not providing flood control functions:
  - Leave in place as strip of upland refuge
  - Lower to high (or lower) intertidal marsh height to provide early vegetation colonization sites
  - Convert to habitat levees by widening interior side to gentle slopes; may or may not lower original levee





# Site Issues for Suisun

## 6. Managing Exotic Species

- Plants, invertebrates, fish
- Peppergrass (*Lepidium latifolium*) the most significant and clear concern
- Pre-emptive establishment of target vegetation?
- Ongoing active removal during early colonization?
- Ripe for identifying appropriate strategies



# Site Issues for Suisun

## 7. Flood Control

- Need to avoid tidal flooding of the neighbors
- In order of presumed lowest to highest flood control requirements (and thus costs) for restoration projects:
  - Island sites presumably have no flood control implications
  - “Peninsula” sites with a small levee length separating neighboring properties require some form of flood control
  - Sites with several neighbors and thus greater levee length require greater amounts of flood control effort



# Site Issues for Suisun

## 8. Infrastructure

- Roads, rail, below and above ground utility lines (petroleum pipelines, electrical transmission lines, sewer lines), gas drilling pads
- Importance of due diligence to know in advance of property acquisition
- Effects highly site specific and range from little or no interference to forcing significant design constraints and/or high infrastructure relocation costs



# Site Issues for Suisun

## 9. Vector Control

- Mosquito production presumed lower in tidal marshes assuming design does not create stagnant water areas
- Compared to managed marshes, lack of water control structures can complicate resolving stagnant areas
- Work with Solano County Mosquito Abatement District early and often



# Site Issues for Suisun

## 10. Contaminants

- A long-recognized desirable function of tidal wetlands are their ability to sequester contaminants from the environment
- However, “excessive” *accumulation* can be a concern
- Methymercury *production* currently the greatest concern and remains an open question
  - Currently an active area of research
  - Important to develop comparative understanding of production rates and differences in bioavailability pathways between existing tidal marsh, restored tidal marsh (including rates at different stages), and managed wetlands





# Links to Regional View – Next Talks

- **Salinity and hydrodynamic considerations**
- **Regional conservation issues for avian resources**

